

§42. Divertor Structure under Finite Beta Conditions

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In the heliotron type configuration there exists a relatively thick ergodic region surrounding closed magnetic surfaces. Magnetic field lines there are connecting to the wall through intrinsic 4 divertor legs with field line lengths of several hundred meters. Because of this strong ergodicity in the peripheral region, some different edge characteristics from the tokamak configuration are seen in the heliotron configuration, therefore, precise numerical study has been required, together with experiments, to clarify the characteristics. With regard to divertor plasmas, some interesting phenomena, e.g., asymmetry of divertor flux to target plates, etc, have been observed in LHD. In this situation, more realistic analyses have been desired to explain the experimental results, and to contribute the optimization of the divertor.

For this purpose, a field line tracing code KMAG has been developed to include the finite beta effect in the edge region [1]. First of all, the peripheral magnetic field under finite beta condition is calculated by the 3-dimensional magnetic field analysis code DIAGNO which calculates the response from finite beta equilibria constructed by the free boundary equilibrium code VMEC. Finally this peripheral magnetic field due to equilibrium currents is superimposed on the magnetic field induced by external coils, and then field line tracing is performed by KMAG.

Figure 1 shows the beta dependence on the shift of striking points. It is found that the shift of each striking point is within 15 mm when the beta increases up to 2 %. The magnetic field strength there due to equilibrium currents is in the order of $\sim 10^{-3}$ T, which is reasonable to the shift Δ . The macroscopic effect of finite beta on divertor legs was found to be small, as mentioned above, while another finite beta effect has been observed. When the beta is high enough as 2.2%, ergodicity in the divertor legs becomes large, as shown in Fig.2. The ergodization takes place between two split peaks in the L_c profile, therefore the full width of the leg is not increased by the finite beta effect. The interesting point is that such a beta effect can only be seen in one of four legs. Other legs are slightly changed their striking points, but never changed their ergodicity by the finite beta effect.

Further improvement of the code is needed to be able to calculate the magnetic field in the boundary around LCFS, and the bench mark test with HINT or MFBE should be carried out.

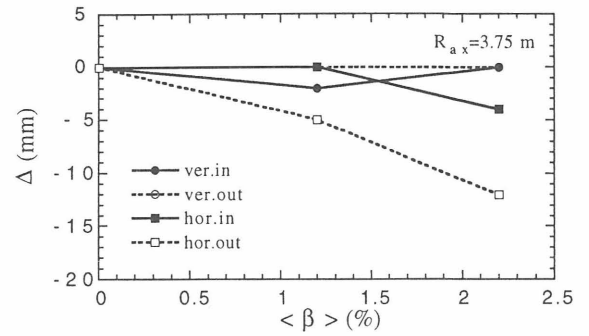


Fig.1. $\langle \beta \rangle$ dependence on shift Δ of striking point.

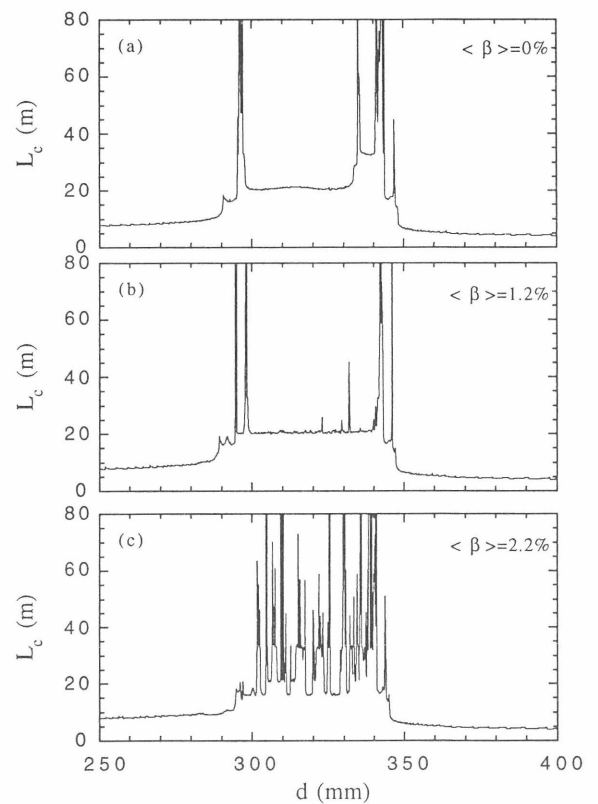


Fig.2. Effect of $\langle \beta \rangle$ on divertor leg structure.

Reference

- 1) Morisaki, T., et al, Contrib. Plasma Phys. 40 (2000) 266